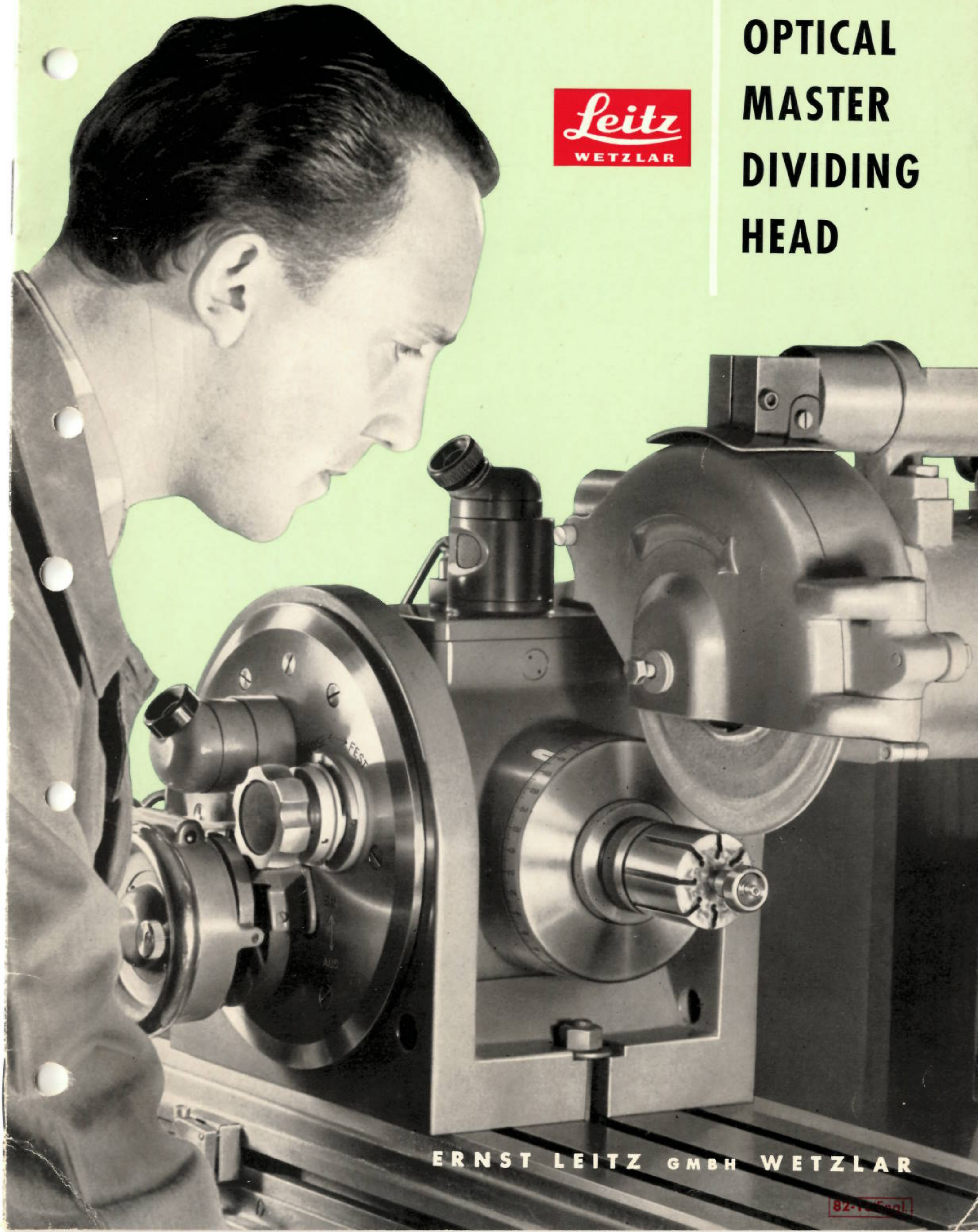
# OPTICAL MASTER DIVIDING HEAD

Leitz
WETZLAR



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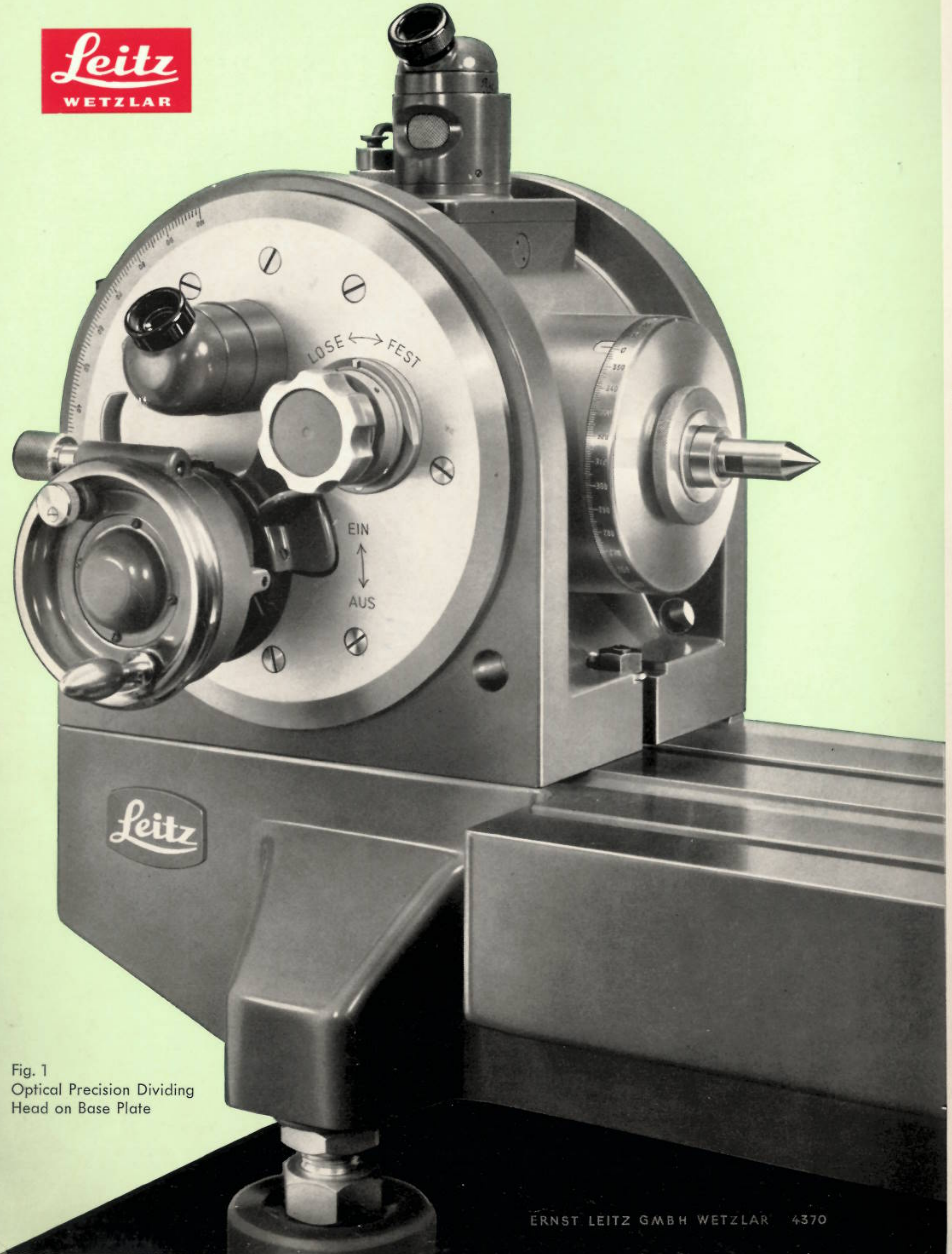


Fig. 1
Optical Precision Dividing
Head on Base Plate

ERNST LEITZ GMBH WETZLAR 4370

# OPTICAL

# MASTER DIVIDING HEAD, MODEL "OTEMA"

## with double microscopic pick-up

### APPLICATION

The Optical Precision Dividing Head covered by this brochure is truly a master indexing device of unsurpassed precision. It combines simplicity of operation with well-planned design and sufficient rigidity to adapt it for shop use. The Dividing Head is especially suitable for the production as well as checking of master gears, index plates, spline gages, cams, and similar parts that require extreme accuracy in angular spacing. As production equipment, it will increase the usefulness of jig borers, precision drilling and grinding machines, horizontal boring machines, etc.

In order to perform light machining operations in the dividing head, a detachable motor drive to the spindle is available, whereby the Dividing Head qualifies within limits as a power tool.

### ANGULAR SETTING WITH OPTICAL COMPENSATION

The reading of angles over the full circle of 360° is performed optically from a master glass circle that is permanently fixed on the spindle to maintain its original concentricity. The direct optical pick-up eliminates any intermediate gearing or other elements that impair the initial accuracy of mechanical dividing heads by progressive wear. The reading ocular is in convenient line of vision. The setting of angles takes place within a softly illuminated field, against which the graduation stands out clearly and positively. The unique principle of "optical compensation" (double microscopic pick-up) offsets automatically any spacing errors that may result from eccentricity, whereby the accuracy of the LEITZ Dividing Head becomes quite extraordinary. The double microscopic pick-up is illustrated diagrammatically on page 9.

### BEARINGS

The spindle is mounted in special spherical ball bearings that were newly developed for this application with the result that it runs freely, but practically without any play whatever in radial or axial direction. The control of eccentricity guarantees an unusually high degree of working accuracy, which the bearing construction will preserve through many years of continuous operation. Please refer to the diagram on page 7 for an explanation of the novel design.

### TILT

To make the Head as universal as possible, the main body may be tilted 100° between horizontal and vertical. It is positively locked in any tilted position by hand brakes. To increase the accuracy of tilt, an optical segment and optical vernier in an inclined eyepiece are provided, instead of mechanical graduation.

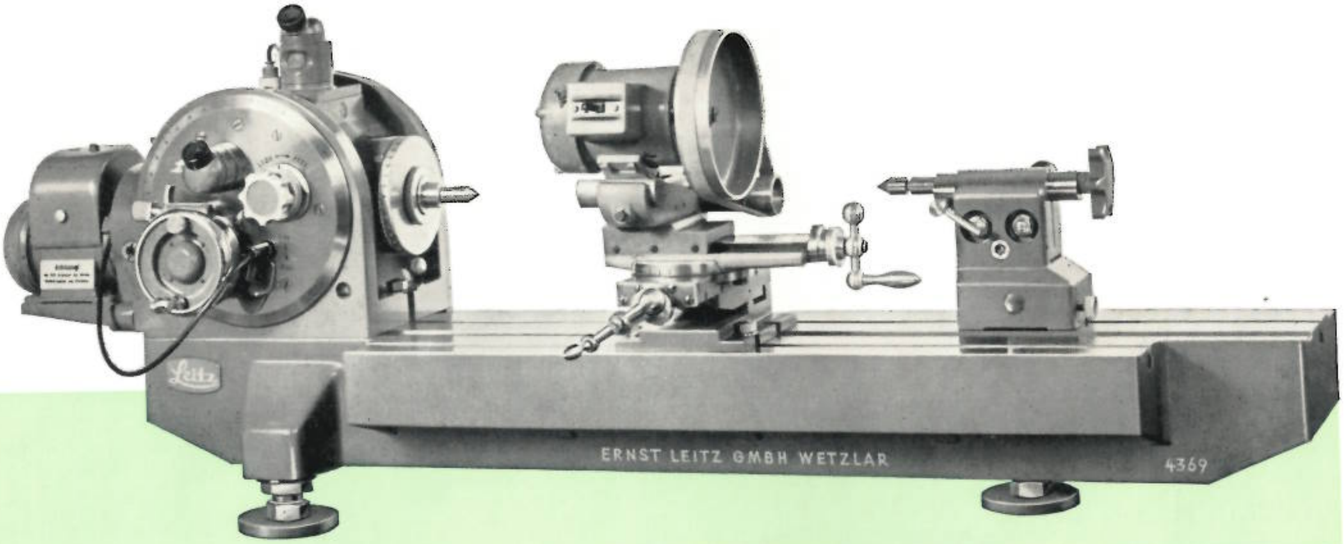


Fig. 2 Optical Precision Dividing Head with attached motor drive and tail-stock set-up on base plate. For grinding operations a compound slide with motorized external and internal grinding attachment is available as an extra.

## EXTERNAL ORIENTATION

With a view of speeding the coarse settings, both for indexing and tilt, outside auxiliary graduations against mechanical index are supplied.

## HAND INDEXING

The quick indexing of the spindle is by large hand wheel with fine adjustment for accurate setting. The spindle is locked in place – completely free of distortion and torque – by means of a differential double-clamp which insures against accidental displacement.

## MOTOR DRIVE

As a singular feature, the spindle in the LEITZ Optical Dividing Head is arranged for motor drive. In this way, it is possible to finish-machine a part for true-running in the head itself, prior to any dividing operation proper, without laborious re-centering. Similarly, the adapter such as the center may be trued-up, whereby a considerable source of error is eliminated.

The reduction motor is attached to the rear of the spindle in horizontal position and drives it through an elastic vibration-proof clutch. The electrical system is self-blocking to prevent damage from accidental engagement.

## BASE PLATE AND SUPPLEMENTARY EQUIPMENT

A base plate (several sizes of which are available) with 2 parallel T-slots and 3-point suspension is part of the standard equipment. It serves for mounting small power tools such as grinding, drilling or milling attachments in addition to the following supplementary inspection equipment:

| | |
|---|---|
| Cam Tester . . . . . . . . . . . . . . | page 9 |
| Optical Zero Indicator for locating by contact against gear teeth, index notches, etc. . . . | page 10 |
| Microscope in mount for optical checking of dials or other circular graduations . . . . . | page 11 |
| Optical Measuring Slide for linear measurements parallel to axis of centers such as lead screws, worms, hobs, etc. . . . . . . . | page 11 |

# SPECIFICATIONS

## DIVIDING HEAD:

| | | |
|---|---|---|
| Range of master circle | 0—360° | |
| Divisions of master circle | 20 min. | |
| Divisions of optical micrometer | 2 sec. | |
| Reading by interpolation | 1 sec. | |
| Inherent accuracy of master circle | ±1 sec. | |
| Working accuracy | ±2 sec. | |

On work which extends from the spindle as in a chuck, the working accuracy is governed by the following formula:

$$\pm\left[2+\frac{8}{R}\cdot\sin\frac{\alpha}{2}\left(1+\frac{A}{8}\right)\right]\text{ second of arc.}$$

R = pitch radius of work in inches, $\alpha$ = angle of spacing, A = distance of surface to be divided from spindle nose in inches. If the tail-stock center is used for outside support the working accuracy will increase considerably.

| | | |
|---|---|---|
| Range of tilt of spindle | 0—100° | |
| Reading of tilt by optical vernier | 1 min. | |
| by interpolation | 30 sec. | |
| Taper in spindle: Morse | No. 4 | |
| Width | approx. 15″ | (385 mm) |
| Height | approx. 15″ | (385 mm) |
| Depth | approx. 13″ | (330 mm) |
| Weight without motor and reduction gear | approx. 176 lbs. | (80 kg) |

## HEIGHT OF CENTERS:

| | | |
|---|---|---|
| Standard center height | 6″ | (150 mm) |
| Increased center height by raiser blocks No. 35 | 7¼″ | (185 mm) |
| Increased center height by raiser blocks No. 150 | 12″ | (300 mm) |

## BASE PLATES: (3 sizes)

| | | I | | II | | III | |
|---|---|---|---|---|---|---|---|
| Width | approx. | 15″ | (370 mm) | 24″ | (610 mm) | 24″ | (610 mm) |
| Height | approx. | 7½″ | (190 mm) | 8½″ | (210 mm) | 13½″ | (340 mm) |
| Length | approx. | 54″ | (1350 mm) | 73″ | (1830 mm) | 96″ | (2400 mm) |
| Working surface | | 54×12″ | (1350×300 mm) | 73×24″ | (1830×610 mm) | 96×24″ | (2400×340 mm) |
| Weight | approx. | 375 lbs. | (170 kg) | 700 lbs. | (325 kg) | 1100 lbs. | (500 kg) |
| Maximum center dist. | | 30″ | (750 mm) | 48″ | (1200 mm) | 72″ | (1800 mm) |

## CAM TESTER:

| | | |
|---|---|---|
| Standard center height | 6″ | (150 mm) |
| Vertical adjustment of same | ±3/8″ | (± 10 mm) |
| Range of measuring plunger | 4″ | (100 mm) |
| Reading of micrometer ocular | .00005″ | (0,001 mm) |
| Measuring Accuracy | ±.00005″ | (± 0,001 mm) |
| Weight | approx. 30 lbs. | (12–15 kg) |

## LINEAR MEASURING SLIDE:

| | | |
|---|---|---|
| Axial travel of measuring plunger | 4″ | (100 mm) |
| Radial travel of contact tip assembly | 2⅜″ | (60 mm) |
| Standard height of measuring plunger above working surface | 6″ | (150 mm) |
| Reading of micrometer ocular | .00005″ | (0,001 mm) |

## CABINET BASE:

| for base plates | I and II | | III | |
|---|---|---|---|---|
| Length (without shelf) | 47″ | (1180 mm) | 75″ | (1900 mm) |
| Height over floor | 32″ | (820 mm) | 28″ | (710 mm) |
| Depth | 20″ | (495 mm) | 27½″ | (700 mm) |
| Shelf surface | 8×14″ | (200×350 mm) | 8×14″ | (200×350 mm) |
| Weight | approx. 220 lbs. | (100 kg) | 440 lbs. | (200 kg) |

# TECHNICAL DESCRIPTION OF THE OPTICAL PRECISION MASTER DIVIDING HEAD, MODEL "OTEMA"

## BASIC EQUIPMENT

### BODY AND SPINDLE BEARINGS

The body which carries the spindle assembly is mounted for inclination within the main housing. Tilting into the desired position is accomplished through a removable hand wheel which engages a worm gear segment. The spindle body is locked in any tilted position within the 100° range by means of two band brakes in the housing. Their action is completely neutral viz. without torque or displacement.

An external circular graduation indicates the approximate degree of inclination from horizontal and facilitates quick coarse adjustment. The exact setting is obtained optically through an inclined eyepiece which may be rotated into the most convenient position for observation, depending upon the amount of tilt. The body carries the spindle bearings. These specially created bearings consist of spherical shells and spherical spindle seats of optical finish, between which a great number of carefully matched balls are arranged in a helical path so that each individual ball only follows its own track. Obviously this arrangement eliminates all play in both directions and combines loadbearing capacity with absence of wear.

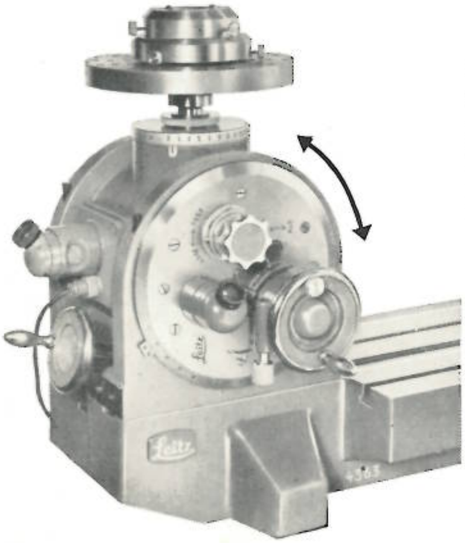


Fig. 3
Shows the precision dividing head in 90° vertical position with face plate mounted in spindle.

### THE SPINDLE

runs by its spherical journals in the spherical bearing shells. Permanently fixed on the spindle are the master circle, a worm wheel and a brake disc.
For quick orientation an adjustable external dial of 360° is provided over the spindle nose.
When locking the spindle a differential double-clamp acts diametrically against the brake disc which is an integral part of the spindle. This new design of spindle lock combines freedom from torque with positive radial and axial fixation regardless of load applied.

### WORM WHEEL AND WORM

These are only used as means of rotation and in no way affect the dividing or measuring accuracy. They are located in the front side of the head in such a way that the worm can be completely swung out of mesh with the wheel. Sensitive fine adjustment can be engaged or disengaged at the operator's choice.

### MASTER CIRCLE

The master circle carries extremely accurate bi-filar divisions in intervals of 20 minutes. In order to cancel out possible errors from eccentricity of the circle and to increase the certainty of measurement, the reading in the eyepiece is by double microscopic pick-up — a principle that has been employed so succesfully in Precision Theodolites. Two microscope objectives pick-up two diametrically opposed bi-filar lines (say 0 and 180) and combine their sharply adjoining images in one plane in such a way that they appear to move in opposite directions during rotation of the circle. Each 20 minutes interval of the master circle is directly divided into 2 seconds of arc by a purely optical micrometer scale which permits readings by interpolation to 1 second. The ocular incorporates correction for the eye of the individual operator to eliminate possible errors from this source.

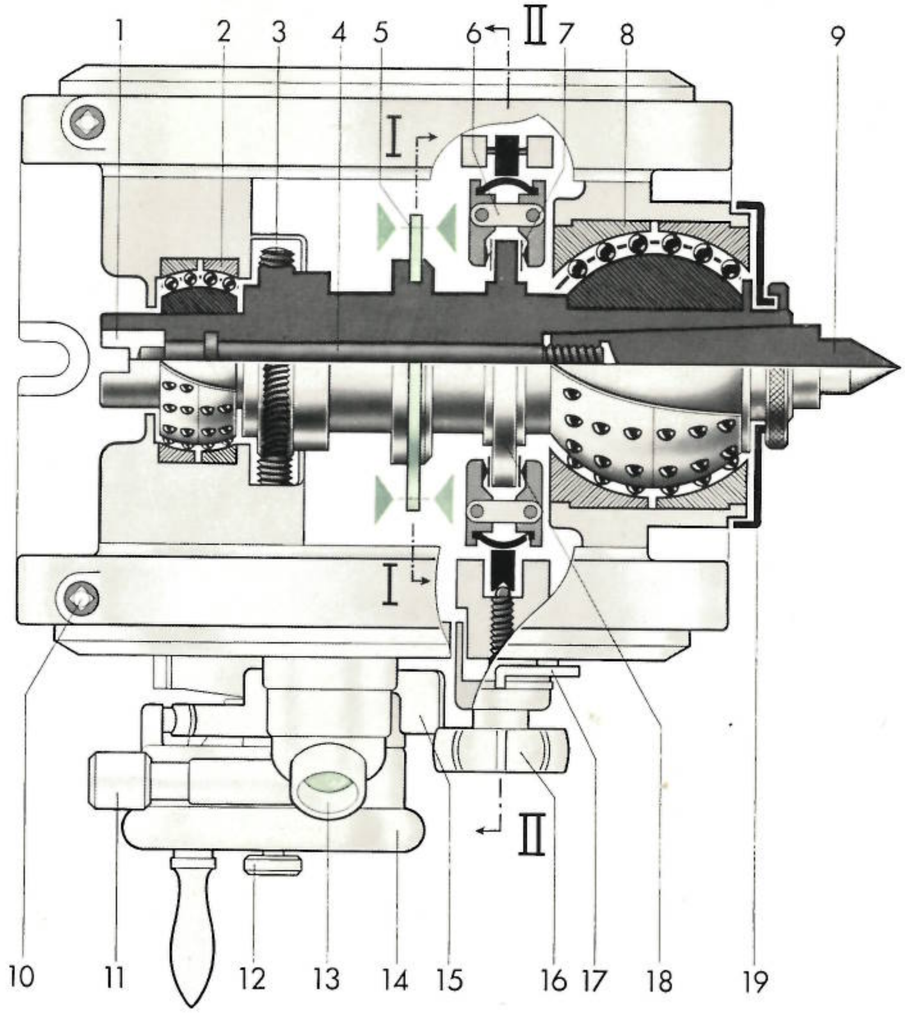


Fig. 4

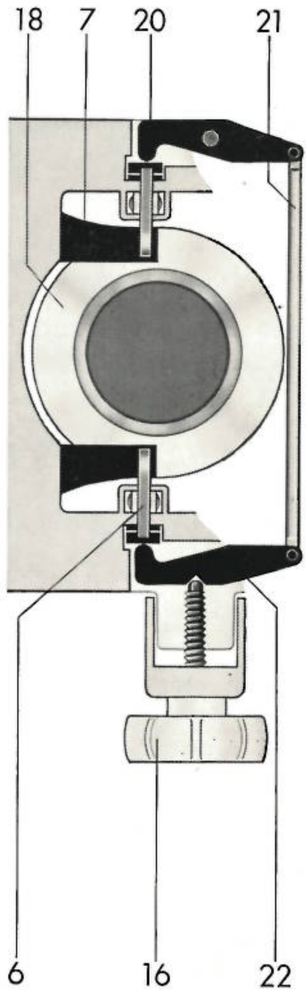


Fig. 5 section II–II

**Fig. 4 Optical Dividing Head with spindle bearings**

1. Connection for motor
2. Rear spherical ball bearing
3. Shaft (handwheel **14**) for rotating spindle
4. Spanner for tightening Morse Taper **9**
5. Master circle; (the path of light is indicated by green triangles)
6. Clamping toggles which through jaws **7** and brake disc **18** lock the spindle
7. Neutral jaws (see **6**)
8. Front spherical ball bearing
9. Morse Taper for holding work adapters
10. Locking arrangement for tilting motion
11. Fine adjustment for spindle **3**
12. Clutch for fine adjustment
13. Micrometer ocular for reading tilt
14. Hand wheel for operating spindle **3**
15. Release for shaft **3** in case of motor drive
16. Star wheel for operating spindle lock
17. Safety pawl for star wheel **16**
18. Brake disc for spindle lock through star wheel **16** and pawl **17**)
19. Adjustable 360° external dial

**Fig. 5**
**Differential Double-Clamp**

By turning star wheel **16** the two toggles **6** will be actuated through links **20, 21** and **22.**

Through neutral jaws **7** and brake disc **18** these toggles lock the spindle and safeguard it against radial or axial displacement under load.

### PRE-SELECTION OF ANGULAR DIVISIONS

The system of optical setting — i. e. the principle of optical compensation — offers the advantage of extreme accuracy, and permits pre-selection of angular divisions below 20 minutes during machining operations.

The following example explains the simple procedure:
Desired setting: 15° 8′ 7″

First the divisions beyond the full 20′ interval are pre-selected on the micrometer scale — 8′ and 7″ in our example — with the result as shown in Fig. 6.1.

The setting is completed by rotating the spindle until the 15° division of the main scale coincides with the triangular index mark (Fig. 6.2). This will (mechanically) incorporate the optically pre-selected amount of 8′ 7″. If, as another example, the next setting should be increased by 30° 30′ 10″, this amount is added to the first figure = 45° 38′ 17″. Again the fractional divisions beyond 20′ are optically pre-selected in this case, 18′ 17″ whereupon the setting is completed by indexing the spindle to 45° 20′ on the main scale, as shown in Fig. 6.3.

### ILLUMINATION

The source of light for the optical reading is a low voltage lamp of 8 V, 0.6 amps. which is easily replaceable and operated through a variable transformer on 110 or 220 V A.C., as desired.

### MOTOR DRIVE

One of the characteristic features of the LEITZ Optical Dividing Head is the choice of power drive to the spindle. This power drive makes it possible not only to test, but even to re-finish the work for true-running and also to regrind the center within the spindle. The drive is by a three-phase reduction motor [175 watts, 2775 R.P.M. (50 cycles) respectively 3320 R.P.M. (60 cycles)] which is readily attached or removed as needed. To guard against any vibration in the head, the motor is insulated by shock absorbers and elastic spindle clutch respectively. The spindle runs at 460 R.P.M. (50 cycles) respectively 560 R.P.M. (60 cycles).

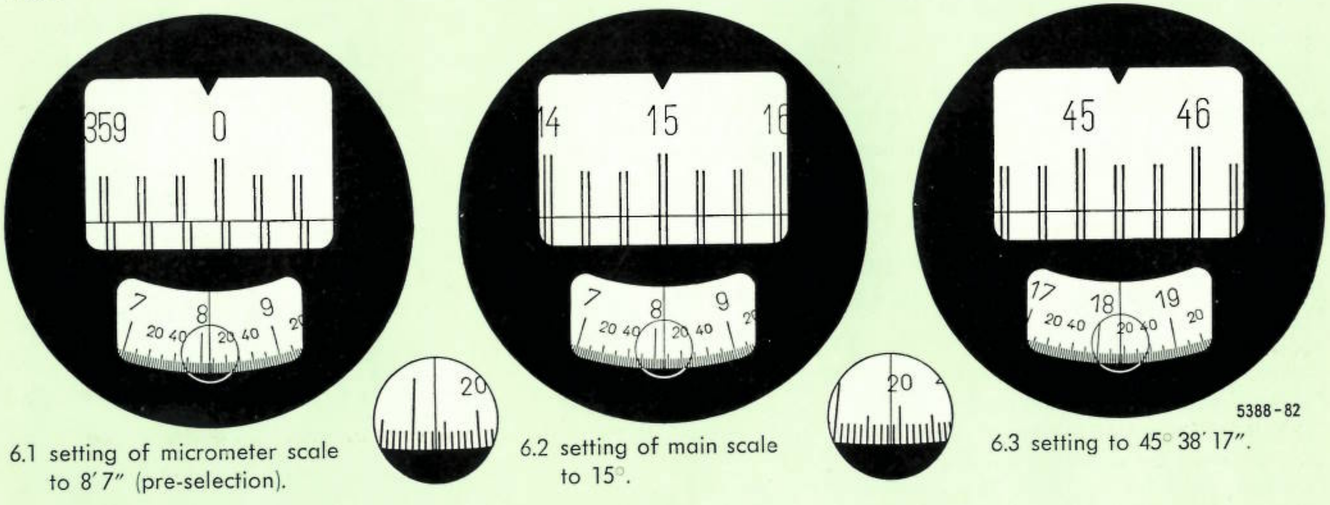
The motor is started through a relay which automatically blocks accidental operation, if the handwheel drive or the spindle lock should remain engaged, in which case the circuit is automatically broken.

## SUPPLEMENTARY EQUIPMENT

### BASE PLATE

Suitable precision base plates in different standard sizes are available as extra equipment. All plates are provided with 2 parallel T-slots. The center slot serves for mounting and aligning the head and tailstock (Morse taper No. 3) respectively. The outside slot will accommo-

Fig. 6



6.1 setting of micrometer scale to 8′ 7″ (pre-selection).

6.2 setting of main scale to 15°.

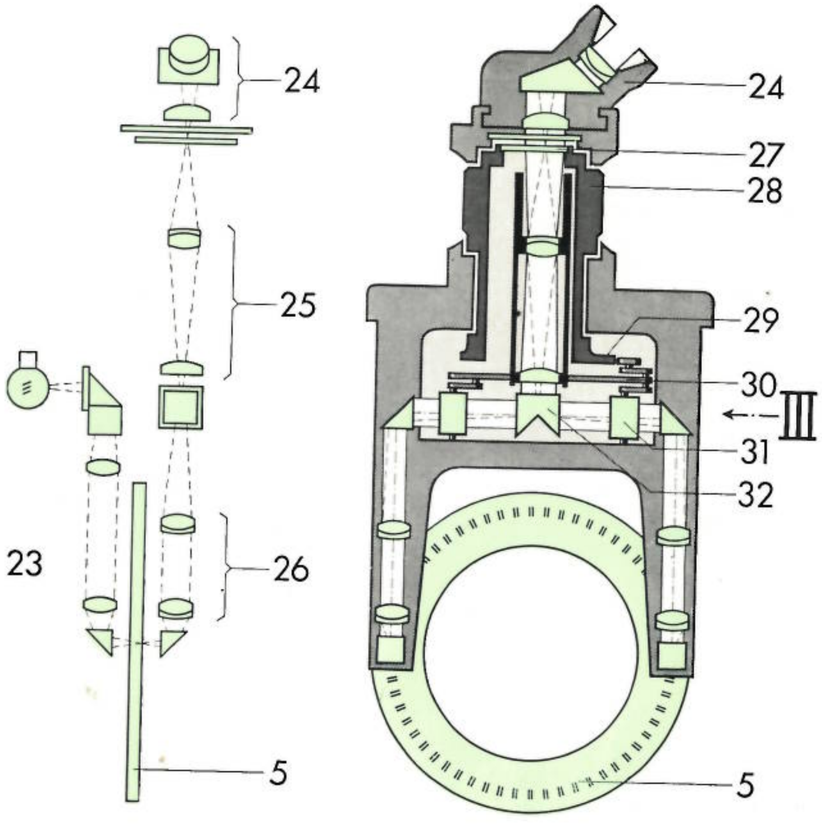
6.3 setting to 45° 38′ 17″.

**Fig. 7**
**Double Microscopic Pick-up of master circle**

- **5.** Master circle with 20 minute bi-filar divisions
- **23.** Light source with illuminator
- **24.** Rotating Ocular
- **25.** Optical relay system
- **26.** Objective

The micrometer scale **27** (2-second divisions) is positively coupled with knurled collar **28.** When turning collar **28** the optical flats **31** through controlled cam **29** and linkage **30** will be tilted against their optical axis. This will displace the images of circle **5** in the upper half of the ocular field of view against each other. The micrometer scale **27** (in the lower half of the field of view) participates in this rotation and indicates the amount of displacement. A complete rotation of the micrometer scale **27** by collar **28** will correspond to a full interval of 20 minutes of circle **5.**

Prism **32** splits the beam for the reading of the master circle. The principle of the double pick-up enables an exact setting within 1 second of arc.



Section I–I

date auxiliary equipment for light machining or supplementary checking operations. A compound slide with high speed grinding attachment is being offered as a standard accessory. All plates have 3-point suspension on levelling bolts. Their surfaces are hand-scraped.

## LOCATION OF WORKPIECES

For locating work on the Optical Dividing Head the spindle nose is equipped with standard No. 4 Morse taper bore acc. DIN 228. The taper bore is finish-ground in the head itself after final adjustment of the spindle bearing to insure absolute true-running. Workpieces which cannot be located directly in the taper bore are either mounted between centers or by means of chucking devices. Besides the No. 4 Morse center which makes part of the standard equipment 3-jaw or 4-jaw chucks, face plates or a draw-in collet attachment are optionally available to accomodate different class of work. An adjustable Tailstock is available for mounting workpieces between centers. It is an indispensable accessory to all Base plates.

## CAM TESTER

This device together with the Optical Precision Dividing Head will facilitate the positive measurement of the fall and rise of cam contours in reference to their polar coordinates. It is therefore invaluable for the checking of individual master cams and cam shafts, or any application where circular measurement in one plane must be combined with linear measurement parallel thereto. The cam tester is located and clamped on the base plate from the outside T-slot within which it can be moved parallel to the line of center without re-locating.

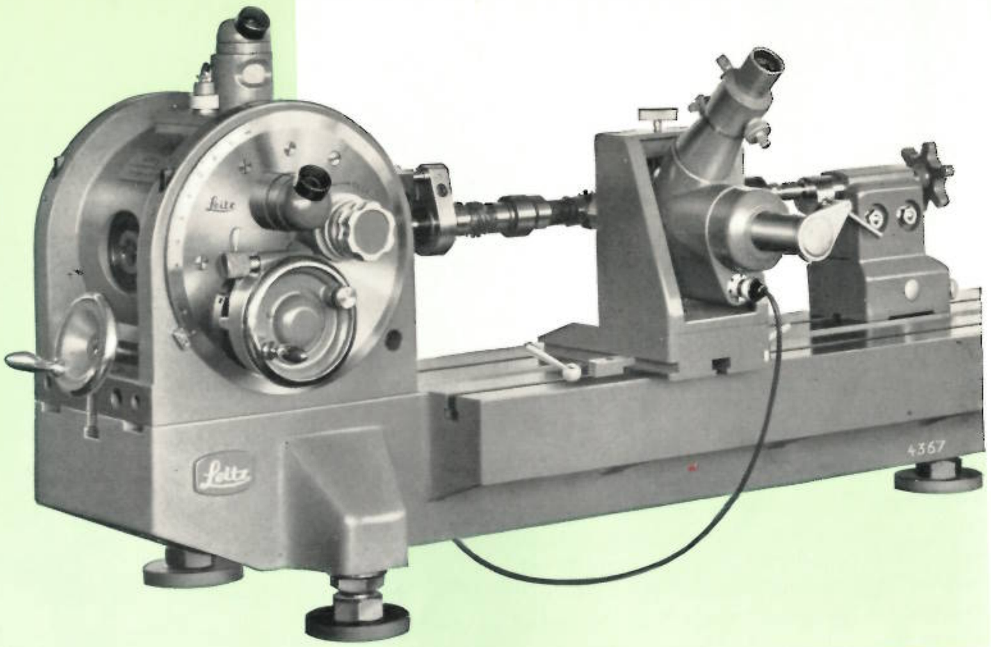
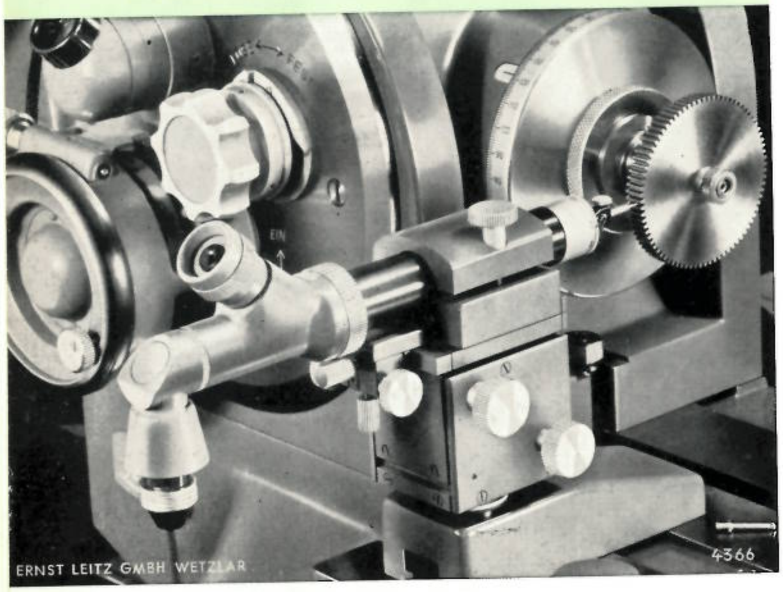


Fig. 8
Cam Tester mounted jointly with Optical Dividing Head and Tailstock on base plate. Cam shaft is held between centers and connected to spindle adapter by driving dog, visible to right of dividing head.

Essentially the tester consists of a horizontal measuring plunger which is guided in a long bearing and contacts the cam contour under a constant pressure of 200 grams. The measuring element is a master glass scale which is read through a measuring ocular in .00005″. Scale and optics are sealed against dust. Illumination is by a replaceable low voltage 8 V. 0.6 amp. lamp. The end of the plunger is a spindle on which are mounted interchangeable contact tips to suit the work in hand. The measuring plunger can be locked in position when changing work or when transporting the instrument. Adjustment to plane of center is through a vertical dovetail slide by knurled fine-pitch screw with means of locking it in position.

Fig. 9 Optical Zero Indicator mounted on base plate. It is held within a fixture which provides horizontal travel through a reed mechanism and orientation through fine adjustment screws.



## OPTICAL ZERO INDICATOR

### for indexing of gears, index plates, splines, etc. by mechanical contact.

This device combines the Optical Zero Indicator as used in other LEITZ instruments with a special mount. It permits zeroing by mechanical contact within an accuracy of .000005″, using a diminutive, but constant, pressure of only ¼ oz. so that possible errors from deformation are guarded against. Contact can be made in two opposite directions through a reversing switch.

The interchangeable ball contact tip tilts a pivoted mirror unit with overload protection, by which a hairline cross is reflected back against fiducial marks in the eyepiece. The latter is of the inclined type and can be rotated 90° for maximum ease of observation. The reticule and fiducial plate are illuminated by a low-voltage 8 V, 0.6 amp. lamp through a variable transformer.

When used for checking operations in conjunction with the optical dividing head, the Zero Indicator proper is furnished in a special mount, whereby it can be moved in and out by a reed mechanism. This horizontal movement is accurately oriented by fine-pitch screws, in addition to vertical adjustment.

A simple device permits rapid adjustment parallel to the T-slot and secure clamping. A clamping arrangement of longer range is available upon special order.

## MICROSCOPE TUBE
### for optical settings on graduated dials, etc.

Instead of the Optical Zero Indicator just described, a microscope tube can be used in the same mount for checking circular divisions of drawn, etched or photographic type, where the lines cannot be mechanically contacted. The microscope is of sturdy design with a standard magnification of 25× and a 3/8″ field. The inclined ocular has individual focusing to a measuring scale of .280″ range with subdivisions in .002″. Special magnification of 50× is optionally available.

## OPTICAL LINEAR MEASURING SLIDE

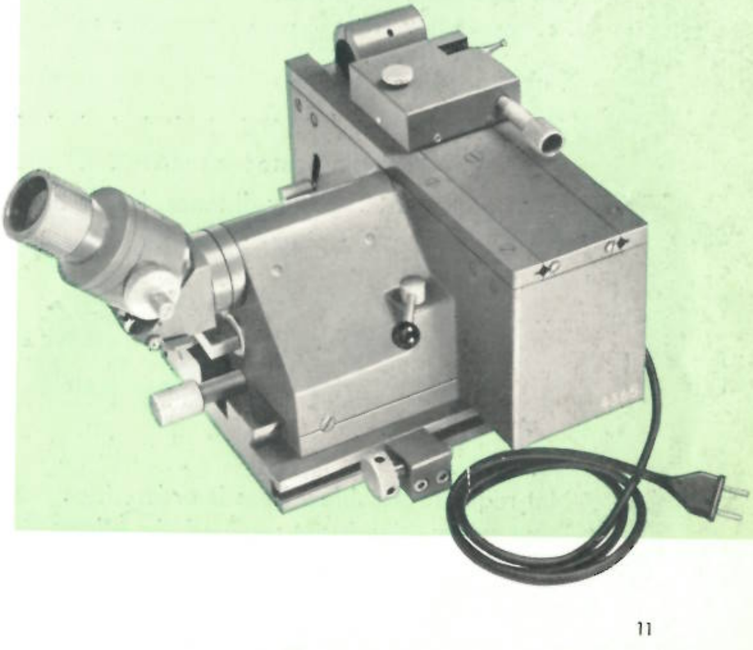
This attachment serves for measurements in axial direction of such items as bell cams, the lead of screws, worms, hobs, etc. It is made up of a bottom plate, the main body and a slide for the contact tip. It is set up on the base plate of the dividing head and has means for aligning it parallel to the line of centers and clamping it in position. The main body together with the slide and the retractable contact tip has 2 3/8″ radial adjustment by knurled fine-pitch screw to accommodate work of varying diameter.

The main body carries a micrometer measuring microscope by which the sliding glass scale is read in .00005″ purely optically. The slide is provided with reversible direction of action, so that the work may be contacted from right or left.

The slide moves in guarded precision ball tracks. It contains the dust-protected master scale, the contact tip and a mount for a dial indicator to help in alignment. The scale is illuminated by a low-voltage 8 V, 0.6 amps. lamp. The contact tip is of ball-type, retractable by knurled screws and properly adjustable to plane of centers.

Fig. 10

The Optical Linear Measuring Slide. The top rear shows the slide proper with contact tip assembly and next to it a sleeve for mounting a dial indicator to check alignment.



# LIST OF EQUIPMENT

## A OPTICAL DIVIDING HEAD, MODEL "OTEMA"

Codeword

1. Cast iron housing; spindle in special bearings, with motor drive.

Double microscopic pick-up of master circle, smallest intervall = 2 sec., with optical pre-selection

Microscopic reading for tilt (direct readings to 1 min., by interpolation to 30 sec.)

Illumination by 8 volt 0.6 amp. lamp for reading of angle and tilt.

Hand indexing by worm wheel and fine setting which can be disengaged.

Differential double-clamp for spindle locking with safety relay for motor drive. 2 band brakes for fixing spindle assembly in tilted position.

360° adjustable dial on outside of spindle.

100° stationary graduation on housing for reading of tilt.

Center (Morse Taper No. 4).

Attachable three phase reduction motor with relay and switch, mounted vibration-proof, including bolts. (State voltage and frequency).

Flexible dust cover.

2 carrying rods.

Rack in which are mounted:
  hand wheel, double end wrench 17/22
  socket wrenches 8 and 10 square.

2 bolts and nuts for clamping dividing head in T-slot, on base plate or machine tool.

Variable transformer "BEEVY"* for 110 V or 220 V.

**BASIC EQUIPMENT**** . . . . . . . . . . . . . . . . . . . . . . . . . . UTSII

Special felt-lined inside shipping case for head . . . . . . . . . . . . . . . . VEROT

**FOR INDEPENDENT OPERATION OF THE OPTICAL DIVIDING HEAD**
**i. e. separately from machine tools, the following additional equipment is recommended:**

| | |
|---|---|
| 2. a) **Baseplate I for 30" (750 mm) center distance,** size 54" × 15" (1350 × 370 mm), with 3 suspension cups | ZGIIS |
| b) **Padded** shipping case for same | VERGB |
| Instead of 30" center distance, larger base plates are available as follows: | |
| c) **Base plate II for 48" (1200 mm) center distance, size 73x24" (1830x610 mm)** | ZGOII |
| d) **Padded shipping case for Base plate II** | GPXAA |
| e) **Base plate III for 72" (1800 mm) center distance, size 96x24" (2400x600 mm)** | ZPIIO |
| f) **Padded shipping case for Base plate III** | GQAAX |

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* Not required if cabinet base is ordered, as BEEVY is built in. Allowance . . . . . . . WGIIM

** If the motor drive is not required, the allowance is . . . . . . . . . . . . . . . UVIIT

## B SUPPLEMENTARY EQUIPMENT

| | Codeword |
|---|---|
| 1. a) **Cabinet Base for proper support of Dividing Head and Base Plate I and II.** Fabricated steel construction; built-in cabinet with door and removable outside bracket. Built-in outlets for motor, transformer and illumination. Built-in transformer for the illumination of auxiliary attachments. 3 suspension cups sunk into top surface. Socket wrench | UWYII |
| b) **Large Cabinet Base for proper Support of Dividing Head and Base Plate III (otherwise as above, but without Socket wrench)** | UVXWI |
| 2. a) **Compound slide for grinding and turning operations with extension spindle, mounting plate and screws.** | |
| b) Cradle ("Fortuna") with motor 2800 R.P.M. for 220/380 V, 50 cycles A.C. for external and internal grinding as well as pulleys of 110 and 180 mm in diameter and cover. | |
| c) High speed quill ("Fortuna") grinding disc flange 20 mm bore including balancing arbor, with pulleys, 26 and 45 mm in diameter and endless belts, 17×600 and 17×710 mm, grease gun and lubricant | UXIIR |
| 3. **Mounting and Chucking Devices** | |
| a) **Tailstock** with 6" (150 mm) swing, adjustable in height 5/32" (4 mm), with Morse Taper No. 3, for locating on base plate or on machine tool table; center; hexagon wrench 19 and Allen wrench 12 | AAGNT |
| b) **Driving dog,** complete with adapter with bushings of 8 mm and 28 mm diameter for receiving standard dial indicators (but exclusive of indicators); Allen wrench 6 | AAGPX |
| c) **Aligning device** for the Dividing Head for adjustment of Head on the Base plate, with hexagon wrench 5 | AAGQZ |
| d) **Raiser Blocks** for increasing swing of Dividing Head and tailstock with necessary fastening bolts, furnished in pairs: | |
| 1. 35 mm to increase swing to 7¼" | ZIIAN |
| 2. 150 mm to increase swing to 12" | ZIIBA |
| e) **Face plate** 10" dia. with No. 4 Morse Taper shank, taped 3/8" | ZIICO |
| f) **Face plate** 10" dia. with No. 4 Morse Taper shank, tapped M 10 | ZIITW |
| g) **4-jaw Westcott-type combination chuck** 6½" dia. with No. 4 Morse Taper shank with combined or individual adjustment of jaws | ZIIDB |
| h) **3-jaw Cushmann-type self-centering chuck** 6½" dia, with No. 4 Morse Taper shank with synchronous adjustment of jaws | ZIIEP |
| i) **3-jaw Westcott-type combination chuck** 6½" dia. with No. 4 Morse Taper shank with synchronous and individual adjustment of bars | ZIIFC |
| k) **Test arbor** with No. 4 Morse Taper for truing-up and orienting Optical Dividing Head | ZIIPD |
| l) **Draw-in collet attachment,** available for 3 C Standard Hardinge collets ½" maximum capacity, or Ortlieb collets 20 mm maximum capacity | ZIISZ |
| m) **Set of female centers** for Optical Dividing Head and tailstock | ZIIHK |
| 4. **Cam Tester** | |
| a) **Cam tester** with horizontal measuring plunger and 4" (100 mm) master scale; Micrometer measuring ocular reading in .00005" (0,001 mm); base with vertical adjustment in dovetail slide; illuminator 8 volt 0.6 amp, Allen wrench 5 | UYIIQ |

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Note: the 3 special shipping cases listed under the standard and supplementary equipment are absolutely necessary for the safe transportation of the parts in question.

| | Codeword |
|---|---|
| b) **Transformer** for illuminator* | BEEVY |
| c) **Padded inside shipping case** | VERNO |
| d) **Special contact tips** | upon inquiry |
| 5. **Optical Zero Indicator for indexing against gears etc. mechanically.** | |
| a) **Optical Zero Indicator** proper with illuminator 8 volt 0.6 amp, swiveling ocular and contact tip in any standard size; to fit slide UZEII | UYCII |
| b) **Shipping case** with inserts | GSAAV |
| c) **Transformer** for illuminator* | BEEVY |
| d) **Slide assembly,** with vertical adjustment and horizontal reed movement, with fine-pitch screws for truing-up, with short clamping device** | UZEII |
| 6. **Microscope for setting against dial divisions optically.** | |
| a) **Microscope tube** with 25× magnification, micrometer ocular in correction mount, to fit mount in slide assembly UZEII | UZIIP |
| b) Upon special order: tube with 50× magnification | ZHIIR |
| c) **Slide assembly,** with vertical adjustment and horizontal reed movement, with fine-pitch screws for truing-up, with short clamping device** | UZEII |
| 7. **Optical Linear Measuring Slide for checking bell cams, leadscrews, worms, hobs etc.** | |
| a) **Complete assembly** consisting of housing, 4″ (100 mm) range of longitudinal measuring slide movement, 2⅜″ (60 mm) range of reed cross movement, adjustment for center height, microscope tube with micrometer measuring ocular reading in .00005″ (0,01 mm), illuminator 8 volt, 0.6 amp., and clamp | ZHQII |
| b) **Transformer** for illuminator* | BEEVY |
| c) **Shipping case** with inserts | GQZAA |
| 8. **Replacement parts** | |
| a) **Replacement** 8 volt 0.6 amp. lamps, screw base | LISEY |
| b) **Replacement** 8 volt 0.6 amp. lamp with centred base | ZYXII |
| c) **Plastic cover** for dividing head (included in UTSII) | IGAAL |

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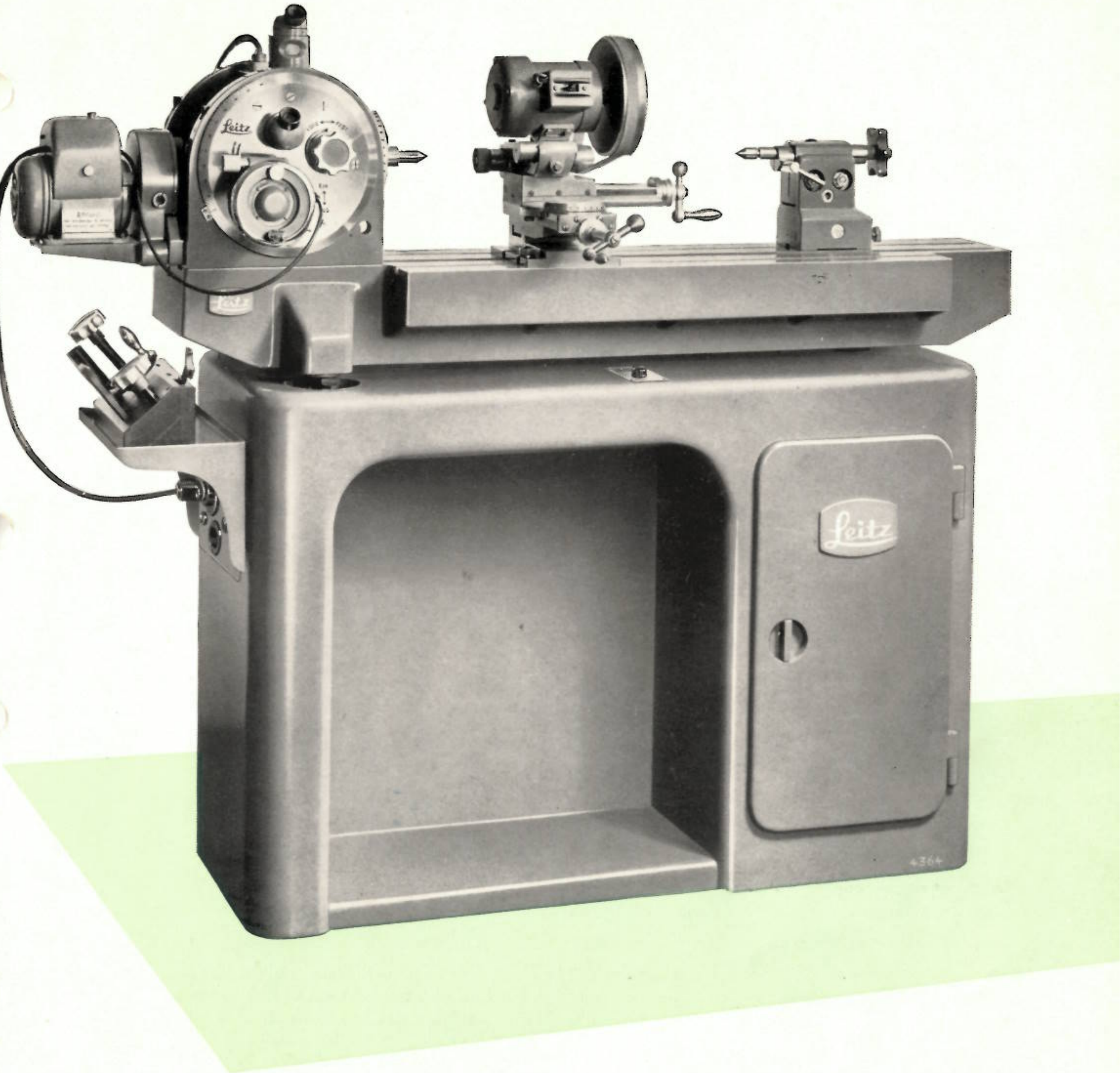
* Not required if cabinet base UWYII is ordered, as BEEVY is built in.

** **Long clamping device** instead of short UZEII . . . . . . . . . . . . . . . . . . UZKLI



## CABINET BASE

To support the Dividing Head and its base plate rigidly and in proper operating height, a fabricated steel pedestal is available as extra equipment. The right side represents a cabinet with shelves and hinged door for storing accessories when not in use. The removable outside bracket accommodates the tool rack, so that all wrenches are within easy reach of the operator. Three suspension cups on which the base plate rests, are sunk into the top surface. The electrical outlets are located beneath the outside bracket, but the variable transformer for the 8 V, 0.6 amp. illuminator on the inside. The pedestal rests on 4 feet, 2 of which are adjustable for levelling.

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Auto-Collimators
Alignment Telescopes
Alignment Microscopes
Optical Dividing Head
Surface Roughness Testers
Miniload-Hardness Tester

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